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Complete Summary

GUIDELINE TITLE

1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction).

BIBLIOGRAPHIC SOURCE(S)

Ryan TJ, Antman EM, Brooks NH, Califf RM, Hillis LD, Hiratzka LF, Rapaport E, Riegel B, Russell RO, Smith EE III, Weaver WD. 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 1999 Sep;34(3):890-911. [849 references] PubMed

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Acute myocardial infarction

GUIDELINE CATEGORY

Diagnosis
Evaluation
Treatment

CLINICAL SPECIALTY

Cardiology
Critical Care

Emergency Medicine
Family Practice
Internal Medicine

INTENDED USERS

Physicians

GUIDELINE OBJECTIVE(S)

To assist physicians and other healthcare providers in clinical decision making by describing a range of generally accepted approaches for the diagnosis, management, and prevention of myocardial infarction.

TARGET POPULATION

Adults with myocardial infarction

INTERVENTIONS AND PRACTICES CONSIDERED

General/Emergency:

- Emergency medical services.
- Advanced cardiovascular life support (ACLS).
- Cardiopulmonary resuscitation (CPR).
- Targeted clinical examination.
- First-responder defibrillation.
- Automated external defibrillation.
- Synchronized electrical cardioversion.
- Unsynchronized electrical cardioversion.
- Twelve-lead telemetry (ECG).
- Continuous electrocardiographic monitoring.
- Supplemental oxygen.
- Intravenous access.

Pharmacotherapy:

- Analgesics (morphine sulfate).
- Angiotensin converting enzyme inhibitors (enalapril).
- Antiarrhythmics (amiodarone, lidocaine, bretylium, procainamide).
- Antithrombotics/Anticoagulants (unfractionated heparin, low molecular weight heparins, glycoprotein IIb/IIIa inhibitors [abciximab, eptifibatide, tirofiban]).
- Antioxidants (vitamin E, beta carotene, recombinant superoxide dismutase).
- Anxiolytics (diazepam).
- Aspirin and other platelet-active drugs (ticlopidine, clopidogrel)
- Atropine.
- ß-adrenoceptor blockers (atenolol, metoprolol).
- Calcium channel blockers (nifedipine, diltiazem, verapamil, amlodipine, felodipine).
- Corticosteroids.
- Electrolytes (magnesium, potassium).

- Estrogen replacement therapy.
- Indomethacin.
- Inotropics agents (digitalis, digoxin, dobutamine, dopamine, norepinephrine, isoproterenol, amrinone, milrinone).
- Lipid-lowering agents: bile acid binding resins (gemfibrozil), HmG Co A reductase inhibitors (simvastatin, pravastatin, fluvastatin), niacin.
- Nitroglycerin.
- Oxygen.
- Smoking cessation (nicotine gum and patches, clonidine, lobeline [under investigation], bupropion)
- Thrombolytic therapy (alteplase, streptokinase, anistreplase, urokinase, reteplase, [TNK-tissue plasminogen activator and lanoteplase under investigation]).

Pacing:

- Temporary pacing:
    - Transcutaneous patches.
    - Active (demand) transcutaneous pacing.
    - Temporary transvenous pacing.
- Permanent pacing.

Noninvasive Measures:

- Exercise Testing.
- Echocardiography.
- Exercise stress echocardiography.
- Dobutamine echocardiography.
- Exercise two-dimensional echocardiography (transthoracic, transesophageal).
- Myocardial perfusion imaging.
- Radionuclide imaging.
- Exercise, vasodilator stress nuclear scintigraphy.
- Dipyridamole or adenosine stress perfusion nuclear scintigraphy.
- Ambulatory (Holter) monitoring.
- Signal-averaged ECG.
- Heart rate variability.
- Baroreflex sensitivity monitoring.

Invasive Measures:

- Balloon flotation right-heart catheter monitoring.
- Intra-arterial pressure monitoring.
- Intra-aortic balloon counterpulsation.
- Percutaneous transluminal coronary angioplasty (PTCA).
- Coronary artery bypass graft (CABG) surgery.
- Coronary angiography.
- Surgical repair of mechanical defects.
- Circulatory support devices (prosthetic ventricles, LV turbine (Hemopump), percutaneous cardiopulmonary bypass circuits).
- Cardiac transplantation.

Laboratory evaluation:

- Serum cardiac biochemical markers (creatinine kinase-MB, CK-MB isoforms, cardiac troponins, myoglobin).

Secondary prevention:

- Patient/family education.
- Exercise.
- Smoking cessation.
- AHA Step II diet.

MAJOR OUTCOMES CONSIDERED

1. Morbidity and mortality due to myocardial infarction
2. Secondary prevention of myocardial infarction

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Pertinent medical literature in the English language was identified by a search of standard library databases. Literature citations were generally restricted to published manuscripts appearing in journals listed in Index Medicus. Published abstracts (previously refereed) were cited when they were the only published information available.

NUMBER OF SOURCE DOCUMENTS

Approximately 5,000

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Highest priority was given to randomized controlled trials. Second highest priority was given to observational database reports. Lowest priority was given to expert opinions.

METHODS USED TO ANALYZE THE EVIDENCE

Meta-Analysis of Randomized Controlled Trials
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Experts in the subject under consideration are selected from the American College of Cardiology (ACC) and the American Heart Association (AHA) to examine subject-specific data and write guidelines. The process includes additional representatives from other medical specialty groups when appropriate. Writing groups are specifically charged to perform a formal literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that might influence the choice of particular tests or therapies are considered as well as frequency of follow-up and cost-effectiveness.

The current committee was convened by the ACC/AHA Task Force on Practice Guidelines and charged at its first meeting, held November 12, 1994, "to review a critical body of knowledge that has accumulated since the 1990 publication of the ACC/AHA Guidelines on Acute Myocardial Infarction (AMI) and recommend whatever changes or revisions of the original guidelines that seem appropriate." The committee held seven 2-day meetings, convened 11 conference calls, and concluded its business at a final meeting held March 24, 1996. An estimated 5000 publications were reviewed by committee members during the course of their deliberations. The committee reviewed many documents on the management or aspects of management of patients with acute myocardial infarction published by other organizations, such as the American College of Chest Physicians, the American College of Physicians, the Canadian Cardiovascular Society, and the European Society of Cardiology; in addition, the committee made every effort to adhere to well-established guidelines such as those for advanced cardiac life support (ACLS) and use of automatic defibrillation. The resulting report was published in the Journal of the American College of Cardiology in November 1996. The committee has continuously monitored the literature since the 1996 report to ensure relevancy of its recommendations. The guidelines have been updated in 1999 via the ACC and AHA websites to include the most significant advances that have occurred in the management of patients with AMI since publication in 1996.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Class I: Conditions for which there is evidence for and/or general agreement that a given procedure or treatment is beneficial, useful, and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

Class IIa: Weight of evidence/opinion is in favor of usefulness/efficacy.

Class IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that a procedure/treatment is not useful/effective and in some cases may be harmful.

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The document was reviewed by three outside reviewers nominated by the American College of Cardiology (ACC), three outside reviewers nominated by the American Heart Association (AHA), as well as individuals from the American Academy of Family Physicians, the American College of Emergency Physicians, the American Association of Critical-Care Nurses, the AHA Council on Cardiovascular Nursing, the American Society of Echocardiography, and the American Society of Nuclear Cardiology. The guidelines were approved by the governing bodies of the ACC and the AHA. The document was reviewed and approved by the ACC Board of Trustees and the AHA Science Advisory and Coordinating Committee.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Please note: This guideline has been updated. The National Guideline Clearinghouse (NGC) is working to update this summary. The recommendations that follow are based on the previous version of the guideline.

The final recommendations for indications for a diagnostic procedure, a particular therapy, or an intervention summarize both the evidence and expert opinion and are expressed in the ACC/AHA format as follows:

Class I: Conditions for which there is evidence for and/or general agreement that a given procedure or treatment is beneficial, useful, and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

Class IIa: Weight of evidence/opinion is in favor of usefulness/efficacy.

Class IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that a procedure/treatment is not useful/effective and in some cases may be harmful.

Prehospital Issues

Class I

1. Availability of 911 access.
2. Availability of an emergency medical services (EMS) system staffed by persons trained to treat cardiac arrest with defibrillation if indicated and to triage patients with ischemic-type chest discomfort.

Class IIa

1. Availability of a first-responder defibrillation program in a tiered response system.
2. Healthcare providers educate patients/families about signs and symptoms of acute MI, accessing EMS, and medications.

Class IIb

1. Twelve-lead telemetry.
2. Prehospital thrombolysis in special circumstances (e.g., transport time greater than 90 minutes).

Initial Recognition and Management in the Emergency Department

Class I

1. Emergency department acute MI protocol that yields a targeted clinical examination and a 12-lead ECG within 10 minutes and a door-to-needle time that is less than 30 minutes.

Routine Measures

1. Supplemental oxygen, intravenous access, and continuous electrocardiographic monitoring should be established in all patients with acute ischemic-type chest discomfort.
2. An ECG should be obtained and interpreted within 10 minutes of arrival in the ED in all patients with suspected acute ischemic-type chest discomfort.

Oxygen

Class I

1. Overt pulmonary congestion.
2. Arterial oxygen desaturation (SaO_2 less than 90%).

Class IIa

1. Routine administration to all patients with uncomplicated MI during the first 2 to 3 hours.

Class IIb

1. Routine administration of supplemental oxygen to patients with uncomplicated MI beyond 3 to 6 hours.

Intravenous Nitroglycerin

Class I

1. For the first 24 to 48 hours in patients with acute MI and CHF, large anterior infarction, persistent ischemia, or hypertension.
2. Continued use (beyond 48 hours) in patients with recurrent angina or persistent pulmonary congestion.

Class IIa

None.

Class IIb

1. For the first 24 to 48 hours in all patients with acute MI who do not have hypotension, bradycardia, or tachycardia.
2. Continued use (beyond 48 hours)[*] in patients with a large or complicated infarction.

Class III

1. Patients with systolic blood pressure less than 90 mm Hg or severe bradycardia (less than 50 bpm).

Aspirin

Class I

1. A dose of 160 to 325 mg should be given on day 1 of acute MI and continued indefinitely on a daily basis thereafter.

Class IIb

1. Other antiplatelet agents such as dipyridamole, ticlopidine or clopidogrel may be substituted if true aspirin allergy is present or if the patient is unresponsive to aspirin.

Atropine

Class I

1. Sinus bradycardia with evidence of low cardiac output and peripheral hypoperfusion or frequent premature ventricular complexes at onset of symptoms of acute MI.
2. Acute inferior infarction with type I second- or third-degree atrioventricular (AV) block associated with symptoms of hypotension, ischemic discomfort, or ventricular arrhythmias.
3. Sustained bradycardia and hypotension after administration of nitroglycerin.
4. For nausea and vomiting associated with administration of morphine.
5. Ventricular asystole.

Class IIa

1. Symptomatic patients with inferior infarction and type I second- or third-degree heart block at the level of the AV node (i.e., with narrow QRS complex or with known existing bundle-branch block [BBB]).

Class IIb

1. Administration concomitant with (before or after) administration of morphine in the presence of sinus bradycardia.
2. Asymptomatic patients with inferior infarction and type I second-degree heart block or third-degree heart block at the level of the AV node.
3. Second- or third-degree AV block of uncertain mechanism when pacing is not available.

Class III

1. Sinus bradycardia greater than 40 bpm without signs or symptoms of hypoperfusion or frequent premature ventricular contractions.
2. Type II AV block and third-degree AV block and third-degree AV block with new wide QRS complex presumed due to acute MI.

Thrombolysis

Class I

1. ST elevation (greater than 0.1 mV, two or more contiguous leads),[**] time to therapy 12 hours or less,[***] age less than 75 years.
2. Bundle branch block (obscuring ST-segment analysis) and history suggesting acute MI.

Class IIa

1. ST elevation,[**] age 75 years or older.

Class IIb

1. ST elevation,[**] time to therapy greater than 12 to 24 hours.[***]
2. Blood pressure on presentation greater than 180 mm Hg systolic and/or greater than 110 mm Hg diastolic associated with high-risk MI.

Class III

1. ST elevation,[**] time to therapy greater than 24 hours,[***] ischemic pain resolved.
2. ST-segment depression only.

Primary Percutaneous Transluminal Coronary Angioplasty (PTCA)

Class I

1. As an alternative to thrombolytic therapy in patients with AMI and ST-segment elevation or new or presumed new LBBB who can undergo angioplasty of the infarct artery within 12 hours of onset of symptoms or greater than 12 hours if ischemic symptoms persist, if performed in a timely fashion[*++] by persons skilled in the procedure[+] and supported by experienced personnel in an appropriate laboratory environment.[++]
2. In patients who are within 36 hours of an acute ST-elevation/Q-wave or new LBBB MI who develop cardiogenic shock, are <75 years old, and in whom revascularization can be performed within 18 hours of onset of shock.

Class IIa

1. As a reperfusion strategy in candidates for reperfusion who have a contraindication to thrombolytic therapy.

Class IIb

1. In patients with AMI who do not present with ST elevation but who have reduced (less than TIMI [Thrombolysis in Myocardial Infarction] grade 2) flow of the infarct-related artery and when angioplasty can be performed within 12 hours of onset of symptoms.

Class III

This category applies to patients with AMI who

1. Undergo elective angioplasty of a non-infarct-related artery at the time of AMI
2. Are less than 12 hours after onset of symptoms and have no evidence of myocardial ischemia
3. Have received fibrinolytic therapy and have no symptoms of myocardial ischemia
4. Are eligible for thrombolysis and are undergoing primary angioplasty performed by a low volume operator in a laboratory without surgical capability

Early Coronary Angiography in the ST-Segment Elevation or Bundle Branch Block Cohort Not Undergoing Primary PTCA

Class I

None.

Class IIa

1. Patients with cardiogenic shock or persistent hemodynamic instability.

Class IIb

1. Patients with evolving large or anterior infarcts treated with thrombolytic agents in whom it is believed that the artery is not patent and adjuvant PTCA is planned.

Class III

1. Routine use of angiography and subsequent PTCA within 24 hours of administration of thrombolytic agents.

Emergency or Urgent Coronary Artery Bypass Graft (CABG) Surgery

Class I

1. Failed angioplasty with persistent pain or hemodynamic instability in patients with coronary anatomy suitable for surgery.
2. Acute MI with persistent or recurrent ischemia refractory to medical therapy in patients with coronary anatomy suitable for surgery who are not candidates for catheter intervention.
3. At the time of surgical repair of postinfarction ventricular septal defect (VSD) or mitral valve insufficiency.

Class IIa

1. Cardiogenic shock with coronary anatomy suitable for surgery.

Class IIb

1. Failed PTCA and small area of myocardium at risk; hemodynamically stable.

Class III

1. When the expected surgical mortality rate equals or exceeds the mortality rate associated with appropriate medical therapy.

Early Coronary Angiography and/or Interventional Therapy in Non-ST-Segment Elevation Cohort

Class I

1. Patients with persistent or recurrent (stuttering) episodes of symptomatic ischemia, spontaneous or induced, with or without associated ECG changes.
2. Presence of shock, severe pulmonary congestion, or continuing hypotension.

Class IIa

No recommendation

Class IIb

No recommendation

Glycoprotein IIb/IIIa Inhibitors

Class IIa

1. For use in patients experiencing an MI without ST-segment elevation who have some high-risk features and/or refractory ischemia, provided they do not have a major contraindication due to a bleeding risk.

<u>Hospital Management</u>

Early, General Measures

Class I

1. Selection of electrocardiographic monitoring based on infarct location and rhythm.
2. Bed rest with bedside commode privileges for initial 12 hours in hemodynamically stable patients free of ischemic-type chest discomfort.
3. Avoidance of Valsalva.
4. Careful attention to maximum pain relief.

Class IIb

1. Routine use of anxiolytics.

Class III

1. Prolonged bed rest (more than 12 to 24 hours) in stable patients without complications.

Identification and Treatment of the Patient at High Risk

Management of Recurrent Chest Discomfort

Class I

1. Aspirin for pericarditis.
2. ÃŸ-Adrenoceptor blockers intravenously, then orally for ischemic-type chest discomfort.
3. (Re)administration of thrombolytic therapy (alteplase) for patients with recurrent ST elevation.
4. Coronary arteriography for ischemic-type chest discomfort recurring after hours to days of initial therapy and associated with objective evidence of ischemia in patients who are candidates for revascularization.

Class IIa

1. Nitroglycerin intravenously for 24 hours, then topically or orally for ischemic-type chest discomfort.

Class IIb

1. Corticosteroids for pericarditis.
2. Indomethacin for pericarditis.

Hemodynamic Monitoring

Balloon Flotation Right-Heart Catheter Monitoring

Class I

1. Severe or progressive CHF or pulmonary edema.
2. Cardiogenic shock or progressive hypotension.
3. Suspected mechanical complications of acute infarction, i.e., VSD, papillary muscle rupture, or pericardial tamponade.

Class IIa

1. Hypotension that does not respond promptly to fluid administration in a patient without pulmonary congestion.

Class III

1. Patients with acute infarction without evidence of cardiac or pulmonary complications.

Intra-arterial Pressure Monitoring

Class I

1. Patients with severe hypotension (systolic arterial pressure less than 80 mm Hg) and/or cardiogenic shock.
2. Patients receiving vasopressor agents.

Class IIa

1. Patients receiving intravenous sodium nitroprusside or other potent vasodilators.

Class IIb

1. Hemodynamically stable patients receiving intravenous nitroglycerin for myocardial ischemia.
2. Patients receiving intravenous inotropic agents.

Class III

1. Patients with acute infarction who are hemodynamically stable.

Intra-aortic Balloon Counterpulsation

Class I

1. Cardiogenic shock not quickly reversed with pharmacological therapy as a stabilizing measure for angiography and prompt revascularization.
2. Acute mitral regurgitation or VSD complicating MI as a stabilizing therapy for angiography and repair/revascularization.
3. Recurrent intractable ventricular arrhythmias with hemodynamic instability
4. Refractory post-MI angina as a bridge to angiography and revascularization.

Class IIa

1. Signs of hemodynamic instability, poor LV function, or persistent ischemia in patients with large areas of myocardium at risk.

Class IIb

1. In patients with successful PTCA after failed thrombolysis or those with three-vessel coronary disease to prevent reocclusion.
2. In patients known to have large areas of myocardium at risk with or without active ischemia.

Rhythm Disturbances

Atrial Fibrillation

Class I

1. Electrical cardioversion for patients with severe hemodynamic compromise or intractable ischemia.
2. Rapid digitalization to slow a rapid ventricular response and improve LV function.
3. Intravenous ÃŸ-adrenoceptor blockers to slow a rapid ventricular response in patients without clinical LV dysfunction, bronchospastic disease, or AV block.
4. Heparin should be given.

Class IIa

1. Either diltiazem or verapamil intravenously to slow a rapid ventricular response if ÃŸ-adrenoceptor blocking agents are contraindicated or ineffective.

Ventricular Tachycardia/Ventricular Fibrillation

Class I

1. Ventricular fibrillation (VF) should be treated with an unsynchronized electric shock with an initial energy of 200 J; if unsuccessful, a second shock of 200 to 300 J should be given, and, if necessary, a third shock of 360 J.
2. Sustained (more than 30 seconds or causing hemodynamic collapse) polymorphic ventricular tachycardia (VT) should be treated with an unsynchronized electric shock using an initial energy of 200 J; if unsuccessful, a second shock of 200 to 300 J should be given, and, if necessary, a third shock of 360 J.
3. Episodes of sustained monomorphic VT associated with angina, pulmonary edema, or hypotension (blood pressure less than 90 mm Hg) should be treated with a synchronized electric shock of 100 J initial energy. Increasing energies may be used if not initially successful.
4. Sustained monomorphic VT not associated with angina, pulmonary edema, or hypotension (blood pressure less than 90 mm Hg) should be treated with one of the following regimens:
    a. Lidocaine: bolus 1.0 to 1.5 mg/kg. Supplemental boluses of 0.5 to 0.75 mg/kg every 5 to 10 minutes to a maximum of 3 mg/kg total loading dose may be given as needed. Loading is followed by infusion of 2 to 4 mg/min (30 to 50 µg/kg per minute).
    b. Procainamide: 20 to 30 mg/min loading infusion, up to 12 to 17 mg/kg. This may be followed by an infusion of 1 to 4 mg/min.
    c. Amiodarone: 150 mg infused over 10 minutes followed by a constant infusion of 1.0 mg/min for 6 hours and then a maintenance infusion of 0.5 mg/min.
    d. Synchronized electrical cardioversion starting at 50 J (brief anesthesia is necessary).

Class IIa

1. Infusions of antiarrhythmic drugs may be used after an episode of VT/VF but should be discontinued after 6 to 24 hours and the need for further arrhythmia management assessed.
2. Electrolyte and acid-base disturbances should be corrected to prevent recurrent episodes of VF when an initial episode of VF has been treated.

Class IIb

1. Drug-refractory polymorphic VT should be managed by aggressive attempts to reduce myocardial ischemia, including therapies such as β-adrenoceptor blockade, intra-aortic balloon pumping, and emergency PTCA/CABG surgery. Amiodarone, 150 mg infused over 10 minutes followed by a constant infusion of 1.0 mg/min for up to 6 hours and then a maintenance infusion of 0.5 mg/min may also be helpful.

Class III

1. Treatment of isolated ventricular premature beats, couplets, runs of accelerated idioventricular rhythm, and nonsustained VT.
2. Prophylactic administration of antiarrhythmic therapy when using thrombolytic agents.

Bradyarrhythmias and Heart Block

Atropine

Class I

1. Symptomatic sinus bradycardia (generally, heart rate less than 50 bpm associated with hypotension, ischemia, or escape ventricular arrhythmia).
2. Ventricular asystole.
3. Symptomatic AV block occurring at the AV nodal level (second-degree type I or third degree with a narrow-complex escape rhythm).

Class IIa

None.

Class III

1. Atrioventricular block occurring at an infranodal level (usually associated with anterior MI with a wide-complex escape rhythm).
2. Asymptomatic sinus bradycardia.

Temporary Pacing

Placement of Transcutaneous Patches[+++] and Active (Demand) Transcutaneous Pacing[Ã§]

Class I

1. Sinus bradycardia (rate less than 50 bpm) with symptoms of hypotension (systolic blood pressure less than 80 mm Hg) unresponsive to drug therapy.[Ã§]
2. Mobitz type II second-degree AV block.[Ã§]
3. Third-degree heart block.[Ã§]
4. Bilateral BBB (alternating BBB, or RBBB and alternating left anterior fascicular block [LAFB], left posterior fascicular block [LPFB]) (irrespective of time of onset).[+++]
5. Newly acquired or age indeterminate LBBB, LBBB and LAFBa, RBBB, and LPFBa.[+++]
6. RBBB or LBBB and first-degree AV block.[+++]

Class IIa

1. Stable bradycardia (systolic blood pressure greater than 90 mm Hg, no hemodynamic compromise, or compromise responsive to initial drug therapy).[+++]
2. Newly acquired or age-indeterminate RBBB.[+++]

Class IIb

1. Newly acquired or age-indeterminate first-degree AV block.[+++]

Class III

1. Uncomplicated acute MI without evidence of conduction system disease.

Temporary Transvenous Pacing^{§§}

Class I

1. Asystole.
2. Symptomatic bradycardia (includes sinus bradycardia with hypotension and type I second-degree AV block with hypotension not responsive to atropine).
3. Bilateral BBB (alternating BBB or RBBB with alternating LAFB/LPFB) (any age).
4. New or indeterminate age bifascicular block (RBBB with LAFB or LPFB, or LBBB) with first-degree AV block.
5. Mobitz type II second-degree AV block.

Class IIa

1. RBBB and LAFB or LPFB (new or indeterminate).
2. RBBB with first-degree AV block.
3. LBBB, new or indeterminate.
4. Incessant VT, for atrial or ventricular overdrive pacing.
5. Recurrent sinus pauses (greater than 3 seconds) not responsive to atropine.

Class IIb

1. Bifascicular block of indeterminate age.
2. New or age-indeterminate isolated RBBB.

Class III

1. First-degree heart block.
2. Type I second-degree AV block with normal hemodynamics.
3. Accelerated idioventricular rhythm.
4. Bundle branch block or fascicular block known to exist before acute MI.

Permanent Pacing After Acute Myocardial Infarction

Class I

1. Persistent second-degree AV block in the His-Purkinje system with bilateral BBB or complete heart block after acute MI.
2. Transient advanced (second- or third-degree) AV block and associated BBB.§§§
3. Symptomatic AV block at any level.

Class IIb

1. Persistent advanced (second- or third-degree) block at the AV node level.

Class III

1. Transient AV conduction disturbances in the absence of intraventricular conduction defects.
2. Transient AV block in the presence of isolated LAFB.
3. Acquired LAFB in the absence of AV block.
4. Persistent first-degree AV block in the presence of BBB that is old or age indeterminate.

Other Surgical Interventions

Emergency or Urgent Cardiac Repair of Mechanical Defects

Class I

1. Papillary muscle rupture with severe acute mitral insufficiency.
2. Postinfarction VSD or free wall rupture.
3. Postinfarction ventricular aneurysm associated with intractable ventricular tachyarrhythmias and/or pump failure (urgent).

Class III

1. Acute infarctectomy in hemodynamically stable patients.

Rationale and Approach to Pharmacotherapy

Antithrombotics/Anticoagulants

Unfractionated Heparin

Class I

1. Patients undergoing percutaneous or surgical revascularization.

Class IIa

1. Intravenously in patients undergoing reperfusion therapy with alteplase. Comment: The recommended regimen is 60 U/kg as a bolus at initiation of alteplase infusion, then an initial maintenance dose of approximately 12 U/kg per hour (with a maximum of 4000 U bolus and 1000 U/h infusion for patients weighing >70 kg), adjusted to maintain aPTT at 1.5 to 2.0 times control (50 to 70 seconds) for 48 hours. Continuation of heparin infusion beyond 48 hours should be considered in patients at high risk for systemic or venous thromboembolism.
2. Intravenous unfractionated heparin (UFH) or low-molecular-weight heparin (LMWH) subcutaneously for patients with non-ST elevation MI.
3. Subcutaneous UFH (e.g., 7500 U BID) or LMWH (e.g., enoxaparin 1 mg/kg BID) in all patients not treated with thrombolytic therapy who do not have a contraindication to heparin. In patients who are at high risk for systemic emboli (large or anterior MI, atrial fibrillation [AF], previous embolus, or known LV thrombus), intravenous heparin is preferred.
4. Intravenously in patients treated with nonselective thrombolytic agents (streptokinase, anistreplase, urokinase) who are at high risk for systemic

emboli (large or anterior MI, AF, previous embolus, or known LV thrombus). Comment: It is recommended that heparin be withheld for 6 hours and that aPTT testing begin at that time. Heparin should be started when aPTT returns to less than two times control (about 70 seconds), then infused to keep aPTT 1.5 to 2.0 times control (initial infusion rate about 1000 U/h). After 48 hours, a change to subcutaneous heparin, warfarin, or aspirin alone should be considered.

Class IIb

1. Patients treated with nonselective thrombolytic agents, not at high risk, subcutaneous heparin, 7500 U to 12500 U twice a day until completely ambulatory.

Class III

1. Routine intravenous heparin within 6 hours to patients receiving a nonselective fibrinolytic agent (streptokinase, anistreplase, urokinase) who are not at high risk for systemic embolism.

ÃŸ-Adrenoceptor Blocking Agents

Early Therapy

Class I

1. Patients without a contraindication to ÃŸ-adrenoceptor blocker therapy who can be treated within 12 hours of onset of infarction, irrespective of administration of concomitant thrombolytic therapy or performance of primary angioplasty.
2. Patients with continuing or recurrent ischemic pain.
3. Patients with tachyarrhythmias, such as AF with a rapid ventricular response.
4. Non-ST-elevation MI.

Class IIb

1. Patients with moderate LV failure (the presence of bibasilar rales without evidence of low cardiac output) or other relative contraindications to beta-adrenoceptor blocker therapy, provided patients can be monitored closely.

Class III

1. Patients with severe LV failure.

Angiotensin Converting Enzyme Inhibitors

Class I

1. Patients within the first 24 hours of a suspected acute MI with ST-segment elevation in two or more anterior precordial leads or with clinical heart failure

in the absence of hypotension (systolic blood pressure less than 100 mm Hg) or known contraindications to use of ACE inhibitors.
2. Patients with MI and LV ejection fraction less than 40% or patients with clinical heart failure on the basis of systolic pump dysfunction during and after convalescence from acute MI.

Class IIa

1. All other patients within the first 24 hours of a suspected or established acute MI, provided significant hypotension or other clear-cut contraindications are absent.
2. Asymptomatic patients with mildly impaired LV function (ejection fraction 40% to 50%) and a history of old MI.

Class IIb

1. Patients who have recently recovered from MI but have normal or mildly abnormal global LV function.

Calcium Channel Blockers

Class I

None.

Class IIa

1. Verapamil or diltiazem may be given to patients in whom ÃŸ-adrenoceptor blockers are ineffective or contraindicated (ie, bronchospastic disease) for relief of ongoing ischemia or control of a rapid ventricular response with AF after acute MI in the absence of CHF, LV dysfunction, or AV block.

Class IIb

1. In non-ST-elevation infarction, diltiazem may be given to patients without LV dysfunction, pulmonary congestion, or CHF. It may be added to standard therapy after the first 24 hours and continued for 1 year.

Class III

1. Nifedipine (short acting) is generally contraindicated in routine treatment of acute MI because of its negative inotropic effects and the reflex sympathetic activation, tachycardia, and hypotension associated with its use.
2. Diltiazem and verapamil are contraindicated in patients with acute MI and associated LV dysfunction or CHF.

Magnesium

Class I

None.

Class IIa

1. Correction of documented magnesium (and/or potassium) deficits, especially in patients receiving diuretics before onset of infarction.
2. Episodes of torsades de pointes-type VT associated with a prolonged QT interval should be treated with 1 to 2 g magnesium administered as a bolus over 5 minutes.

Class IIb

1. Magnesium bolus and infusion in high-risk patients such as the elderly and/or those for whom reperfusion therapy is not suitable.

<u>Preparation for Discharge From the Hospital</u>

Noninvasive Evaluation of Low-Risk Patients

Class I

1. Stress ECG
   a. Before discharge for prognostic assessment or functional capacity (submaximal at 4 to 6 days or symptom limited at 10 to 14 days).
   b. Early after discharge for prognostic assessment and functional capacity (14 to 21 days).
   c. Late after discharge (3 to 6 weeks) for functional capacity and prognosis if early stress was submaximal.

2. Exercise, vasodilator stress nuclear scintigraphy, or exercise stress echocardiography when baseline abnormalities of the ECG compromise interpretation.$

Class IIa

1. Dipyridamole or adenosine stress perfusion nuclear scintigraphy or dobutamine echocardiography before discharge for prognostic assessment in patients judged to be unable to exercise.
2. Exercise two-dimensional echocardiography or nuclear scintigraphy (before or early after discharge for prognostic assessment).

Class III

1. Stress testing within 2 to 3 days of acute MI.
2. Either exercise or pharmacological stress testing at any time to evaluate patients with unstable postinfarction angina pectoris.
3. At any time to evaluate patients with acute MI who have uncompensated CHF, cardiac arrhythmia, or noncardiac conditions that severely limit their ability to exercise.
4. Before discharge to evaluate patients who have already been selected for cardiac catheterization. In this situation an exercise test may be useful after

catheterization to evaluate function or identify ischemia in distribution of a coronary lesion of borderline severity.

Assessment of Ventricular Arrhythmia--Routine Testing

Class I

None.

Class IIa

None.

Class IIb

1. Ambulatory (Holter) monitoring, signal-averaged ECG, heart rate variability, baroreflex sensitivity monitoring, alone or in combination with these or other tests, including functional tests (ejection fraction, treadmill testing) for risk assessment after MI, especially in patients at higher perceived risk, when findings might influence management issues, or for clinical research purposes.

Invasive Evaluation

Coronary Angiography and Possible PTCA

Class I

1. Patients with spontaneous episodes of myocardial ischemia or episodes of myocardial ischemia provoked by minimal exertion during recovery from infarction.
2. Before definitive therapy of a mechanical complication of infarction such as acute mitral regurgitation, VSD, pseudoaneurysm, or LV aneurysm.
3. Patients with persistent hemodynamic instability.

Class IIa

1. When MI is suspected to have occurred by a mechanism other than thrombotic occlusion at an atherosclerotic plaque. This would include coronary embolism, certain metabolic or hematological diseases, or coronary artery spasm.
2. Survivors of acute MI with depressed LV systolic function (LV ejection fraction less than or equal to 40%), CHF, prior revascularization, or malignant ventricular arrhythmias.
3. Survivors of acute MI who had clinical heart failure during the acute episode but subsequently demonstrated well-preserved LV function.

Class IIb

1. Coronary angiography performed in all patients after infarction to find persistently occluded infarct-related arteries in an attempt to revascularize the artery or to identify patients with three-vessel disease.

2. All patients after a non-Q wave MI.
3. Recurrent VT or VF or both, despite antiarrhythmic therapy in patients without evidence of ongoing myocardial ischemia.

Class III

1. Routine use of coronary angiography and subsequent PTCA of the infarct-related artery within days after receiving thrombolytic therapy.
2. Survivors of MI who are thought not to be candidates for coronary revascularization.

Routine Coronary Angiography and PTCA After Successful Thrombolytic Therapy

Class I

None.

Class IIa

None.

Class III

1. Routine PTCA of the stenotic infarct-related artery immediately after thrombolytic therapy.
2. Percutaneous transluminal coronary angioplasty of the stenotic infarct-related artery within 48 hours of receiving a thrombolytic agent in asymptomatic patients without evidence of ischemia.

Secondary Prevention

Management of Lipids

Class I

1. The AHA Step II diet, which is low in saturated fat and cholesterol (less than 7% of total calories as saturated fat and less than 200 mg/d cholesterol), should be instituted in all patients after recovery from acute MI.
2. Patients with LDL cholesterol levels greater than 125 mg/dL despite the AHA Step II diet should be placed on drug therapy with the goal of reducing LDL to less than 100 mg/dL.
3. Patients with normal plasma cholesterol levels who have a high-density lipoprotein (HDL) cholesterol level less than 35 mg/dL should receive nonpharmacological therapy (e.g., exercise) designed to raise it.

Class IIa

1. Drug therapy may be added to diet in patients with LDL cholesterol levels less than 130 mg/dL but greater than 100 mg/dL after an appropriate trial of the AHA Step II diet alone.[$$]

2. Patients with normal total cholesterol levels but HDL cholesterol less than 35 mg/dL despite diet and other nonpharmacological therapy may be started on drugs such as niacin to raise HDL levels.

Class IIb

1. Drug therapy using either niacin or gemfibrozil may be added to diet regardless of LDL and HDL levels when triglyceride levels are greater than 200 mg/dL.

Long-Term ÃŸ-Adrenoceptor Blocker Therapy in Survivors of Myocardial Infarction

Class I

1. All but low-risk patients without a clear contraindication to ÃŸ-adrenoceptor blocker therapy. Treatment should begin within a few days of the event (if not initiated acutely) and continue indefinitely.

Class IIa

1. Low-risk patients without a clear contraindication to ÃŸ-adrenoceptor blocker therapy.
2. Survivors of non-ST-elevation MI

Class IIb

1. Patients with moderate or severe LV failure or other relative contraindication to ÃŸ-adrenoceptor blocker therapy, provided patients can be monitored closely.

Class III

No recommendation

Anticoagulants

Long-Term Anticoagulation After Acute Myocardial Infarction

Class I

1. For secondary prevention of MI in post-MI patients unable to take daily aspirin.[$$$]
2. Post-MI patients in persistent AF.
3. Patients with LV thrombus.

Class IIa

1. Post-MI patients with extensive wall motion abnormalities.
2. Patients with paroxysmal AF.

Class IIb

1. Post-MI patients with severe LV systolic dysfunction with or without CHF.

Estrogen Replacement Therapy and Myocardial Infarction

Class IIa

1. Hormone replacement therapy (HRT) with estrogen plus progestin for secondary prevention of coronary events should not be given de novo to postmenopausal women after AMI.
2. Postmenopausal women who are already taking HRT with estrogen plus progestin at the time of an AMI can continue this therapy.

*Oral or topical preparations may be substituted.

**Repeat ECGs recommended during medical observation in clinical settings when initial ECG is nondiagnostic of ST elevation.

***Time of symptom onset is defined as beginning of continuous persistent discomfort that brought the patient to the hospital.

*++Performance standard: balloon inflation within 90 ($+$ 30) minutes of admission.

+Individuals who perform more than 75 PTCA procedures per year.

++Centers that perform more than 200 PTCA procedures per year and have a cardiac surgical capability.

+++Transcutaneous patches applied; system may be attached and activated within a brief time if needed. Transcutaneous pacing may be very helpful as an urgent expedient. Because it is associated with significant pain, high-risk patients likely to require pacing should receive a temporary pacemaker.

Ã§Apply patches and attach system; system is in either active or standby mode to allow immediate use on demand as required. In facilities in which transvenous pacing or expertise are not available to place an intravenous system, consideration should be given to transporting the patient to one equipped and competent in placing transvenous systems.

Ã§Ã§It should be noted that in choosing an intravenous pacemaker system, patients with substantially depressed ventricular performance, including right ventricular infarction, may respond better to atrial/AV sequential pacing than ventricular pacing.

Ã§Ã§Ã§An electrophysiology study should be considered to assess the site and extent of heart block in uncertain cases.

$Marked abnormalities in the resting ECG such as LBBB, LV hypertrophy with strain, ventricular pre-excitation, or a ventricular paced rhythm render a displacement of ST segments virtually uninterpretable. For patients taking digoxin or who have less than 1 mm ST depression on their resting tracing who undergo

standard stress electrocardiographic testing, it must be realized that further ST depression with exercise may have minimal diagnostic significance.

$$HmG CoA reductase drugs provide the greatest lowering of LDL cholesterol. Niacin is less effective in lowering LDL, although it is more effective in raising HDL levels. Resins are rarely sufficiently effective to be used alone, but they may be used to supplement lowering LDL with either niacin or HmG CoA reductase drugs.

$$$See "Initial Recognition and Management in the Emergency Department," "Aspirin."

CLINICAL ALGORITHM(S)

Clinical algorithms are provided for

1. the management of patients with suspected acute myocardial infarction in the emergency department,
2. the management of patients with ischemic discomfort presenting with or without ST elevation,
3. the management of patients with ST elevation,
4. the management of patients with ST depression/T-wave inversion: suspected AMI, and
5. strategies for exercise test evaluations soon after myocardial infarction.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The analysis of the available evidence, as well as its quality, was critical in making final recommendations and is developed in the text in detail. Similarly, when no evidence was available, this is noted in the text.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

1. Decreased morbidity and mortality due to myocardial infarction
2. Effective secondary prevention of myocardial infarction

Subgroups Most Likely to Benefit:

1. The elderly should be considered candidates for thrombolytic therapy after careful screening for exclusion, given the much greater mortality risk of MI.
2. Certain subgroups of patients with an especially high likelihood of benefiting from successful reperfusion with thrombolytic therapy include those with hypotension, tachycardia, and a history of diabetes mellitus or prior MI.

POTENTIAL HARMS

Potential adverse effects associated with the major recommendations are discussed in greater detail in the guideline document and include the following:

1. Thrombolytic therapy is associated with a slightly increased risk of intracranial hemorrhage (ICH) that usually occurs within the first day of therapy.
2. Complications associated with invasive and surgical interventions (e.g., CABG).

Subgroups Most Likely to be Harmed:

Risk of elective CABG after acute MI is increased for patients with emergency or urgent surgery, older age, and poor ventricular function.

CONTRAINDICATIONS

CONTRAINDICATIONS

Specific patient populations with contraindications for thrombolytic therapy include patients with previous hemorrhagic stroke at any time, patients with other strokes or cerebrovascular events within one year, patients with known intracranial neoplasm, active internal bleeding (which does not include menses) and suspected aortic dissection.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

1. These guidelines attempt to define practices that meet the needs of most patients in most circumstances. The ultimate judgment regarding care of a particular patient must be made by the physician and patient in light of circumstances specific to that patient.
2. Although these guidelines have been shaped largely within the context of evidence-based medical practice, the committee clearly understands that variations in inclusion and exclusion criteria from one randomized trial to another impose some limitation on the generalizability of their findings. Likewise, in its efforts to reconcile conflicting data, the committee emphasized the importance of properly characterizing the population under study.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

RELATED NQMC MEASURES

- Acute myocardial infarction: percent of patients who received a thrombolytic agent within 30 minutes of hospital arrival.

- Acute myocardial infarction: percent of patients who received percutaneous transluminal coronary angioplasty within 90 minutes of hospital arrival.
- Acute myocardial infarction: proportion of inpatient mortality.
- Acute myocardial infarction: percent of patients without aspirin contraindications who received aspirin within 24 hours before or after hospital arrival.
- Acute myocardial infarction: percent of patients without aspirin contraindications who are prescribed aspirin at hospital discharge.
- Acute myocardial infarction: percent of patients with left ventricular systolic dysfunction and without angiotensin converting enzyme inhibitor contraindications who are prescribed an angiotensin converting enzyme inhibitor at discharge.
- Acute myocardial infarction: percent of patients with a history of smoking cigarettes who are given smoking cessation advice or counseling during hospital stay.
- Acute myocardial infarction: percent of patients without beta blocker contraindications who are prescribed a beta blocker at hospital discharge.
- Acute myocardial infarction: percent of patients without beta blocker contraindications who received a beta blocker within 24 hours after hospital arrival.
- Acute myocardial infarction: median time to thrombolysis.
- Acute myocardial infarction: median time to percutaneous transluminal coronary angioplasty.
- Beta-blocker treatment after heart attack: percentage of patients who received an ambulatory prescription for beta-blockers rendered within seven days after hospital discharge with a diagnosis of acute myocardial infarction (AMI).

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness
Timeliness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Ryan TJ, Antman EM, Brooks NH, Califf RM, Hillis LD, Hiratzka LF, Rapaport E, Riegel B, Russell RO, Smith EE III, Weaver WD. 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 1999 Sep;34(3):890-911. [849 references] PubMed

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1996 Nov 1 (revised 1999 Sep)

GUIDELINE DEVELOPER(S)

American College of Cardiology Foundation - Medical Specialty Society
American Heart Association - Professional Association

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The American College of Cardiology Foundation and the American Heart
Association. No outside funding accepted.

GUIDELINE COMMITTEE

American College of Cardiology/American Heart Association Task Force on Practice
Guidelines (Committee on Management of Acute Myocardial Infarction)

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Committee members were selected from cardiovascular specialists with broad
geographical representation and combined involvement in academic medicine and
primary practice. The Committee on Management of Acute Myocardial Infarction
was also broadened by members of the American Academy of Family Physicians,
the American College of Emergency Physicians, the AHA Council on Cardiovascular
Nursing, and the American Association of Critical-Care Nurses.

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

ENDORSER(S)

American Association of Critical-Care Nurses - Professional Association
American College of Emergency Physicians - Medical Specialty Society
American Society of Echocardiography - Professional Association

GUIDELINE STATUS

Please note: This guideline has been updated. The National Guideline Clearinghouse (NGC) is working to update this summary.

GUIDELINE AVAILABILITY

Electronic copies of the updated guideline: Available in Portable Document Format (PDF) from the American College of Cardiology (ACC) Web site.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction: executive summary and recommendations: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). Circulation 1999 Aug 31;100(9):1016-30.

  Electronic copies: Available from the American College of Cardiology (ACC) Web site and the American Heart Association (AHA) Web site.

- ACC/AHA pocket guidelines for the management of patients With acute myocardial infarction.

  Electronic copies available from the ACC Web site: a Pocket Guideline; Pocket Guideline Pull-out Card; or Pocket Guideline Palm Download are available.

Print copies: Available from ACC, Resource Center, 9111 Old Georgetown Rd, Bethesda, MD 20814-1699; (800) 253-4636 (US only). Also available from AHA, Public Information, 7272 Greenville Ave, Dallas TX 75231-4596.

PATIENT RESOURCES

None available

NGC STATUS

The original NGC summary was completed by ECRI on June 30, 1998. The summary was updated by ECRI on September 2, 1999. This updated information was verified by the guideline developer on October 8, 1999.

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